CLAIMS

We claim:

1. A method for improving separation efficiencies comprising the step of

supplying, to a chromatography column, a gaseous coolant at a sufficient flow rate and at a sufficient temperature to produce a negative temperature ramp in the column, where the column includes a continuous phase material forming a wall surrounding an interior space for containing a chromatography sample; and a microwave absorbing material contained in the continuous phase material, where the chromatography column has a loss factor sufficient to absorb at least approximately 50% of the microwave energy transmitted into the microwave heating apparatus and where the negative temperature ramp improves the separation of lower boiling components from higher boiling components or the improve the separation of components having boiling points within a narrow temperature range.

2. The method of claim 1, further comprising the step of:

irradiating the chromatography column with microwave energy sufficient to produce a desired positive temperature ramp.

3. The method of claim 1, further comprising the step of:

holding the chromatography column at a desired temperature and time by supplying sufficient coolant flow at a sufficient temperature to the column and irradiating the column with sufficient microwave energy to hold the column at the desired temperature for the desired time.

4. The method of claim 1, further comprising the step of:

irradiating the chromatography column with microwave energy sufficient to produce a desired positive temperature ramp, and

holding the chromatography column at a desired temperature and time by supplying sufficient coolant flow at a sufficient temperature to the column and irradiating the column with sufficient microwave energy to hold the column at the desired temperature for the desired time.

5. The method of claim 4, wherein the steps are performed in any order.

6. A method for improving separation efficiencies comprising the step of

irradiating a chromatography column includes a continuous phase material forming a wall surrounding an interior space for containing a chromatography sample; and a microwave absorbing material contained in the continuous phase material, where the chromatography column has a loss factor sufficient to absorb at least approximately 50% of the microwave energy transmitted into the microwave heating apparatus to produce a desired positive temperature ramp, and

supplying, to the chromatography column, a gaseous coolant at a sufficient flow rate and at a sufficient temperature to produce a negative temperature ramp in the column, where the negative temperature ramp improves the separation of lower boiling components from higher boiling components or the improve the separation of components having boiling points within a narrow temperature range.

7. The method of claim 6, further comprising the step of:

holding the chromatography column at a desired temperature and time by supplying sufficient coolant flow at a sufficient temperature to the column and irradiating the column with sufficient microwave energy to hold the column at the desired temperature for the desired time.

8. The method of claim 6, wherein the steps are performed in any order.

9. The method of claim 7, wherein the steps are performed in any order.

10. A method for improving separation efficiencies comprising the step of

irradiating a chromatography column includes a continuous phase material forming a wall surrounding an interior space for containing a chromatography sample; and a microwave absorbing material contained in the continuous phase material, where the chromatography column has a loss factor sufficient to absorb at least approximately 50% of the microwave energy transmitted into the microwave heating apparatus to produce a desired positive temperature ramp,

supplying, to the chromatography column, a gaseous coolant at a sufficient flow rate and at a sufficient temperature to produce a negative temperature ramp in the column, where the negative temperature ramp improves the separation of lower boiling components from higher boiling components or the improve the separation of components having boiling points within a narrow temperature range, and

holding the chromatography column at a desired temperature and time by supplying sufficient coolant flow at a sufficient temperature to the column and irradiating the column with sufficient microwave energy to hold the column at the desired temperature for the desired time.

11. The method of claim 10, wherein the steps are performed in any order.

12. A GC separation protocol for a microwave heated GC apparatus comprising at least one positive temperature ramp and at least one negative temperature ramp, where the positive temperature ramp is produced by irradiating a column includes a continuous phase material forming a wall surrounding an interior space for containing a chromatography sample; and a microwave absorbing material contained in the continuous phase material with microwave energy, where the chromatography column has a loss factor sufficient to absorb at least approximately 50% of the supplied microwave energy and where the negative temperature ramp is produced by supply a gaseous coolant to the column at a flow rate and at a temperature sufficient to produce one or more desired negative temperature ramps.

13. The GC separation protocol of claim 12, further comprising at least one hold, where the column is maintained at a desired temperature and for a desired time by supply either coolant and/or a combination of coolant and microwave energy to the column.

14. The GC separation protocol of claim 12, wherein an order of the positive ramps and the negative ramps are designed to achieve a desired separation protocol.

15. The GC separation protocol of claim 13, wherein an order of the positive ramps, the negative ramps and the holds are designed to achieve a desired separation protocol.

16. A GC separation protocol for a microwave heated GC apparatus comprising one or a plurality of positive temperature ramps, one or a plurality of holds, and one or a plurality of negative temperature ramps, where each positive temperature ramp is produced by irradiating a column includes a continuous phase material forming a wall surrounding an interior space for containing a chromatography sample; and a microwave absorbing material contained in the continuous phase material with microwave energy, where the chromatography column has a loss factor sufficient to

absorb at least approximately 50% of the supplied microwave energy, where the column is maintained at a desired temperature and for a desired time by supply either coolant and/or a combination of coolant and microwave energy to the column, and where each negative temperature ramp is produced by supply a gaseous coolant to the column at a flow rate and at a temperature sufficient to produce one or more desired negative temperature ramps.

17. The GC separation protocol of claim 12, wherein an order of the positive ramps, the negative ramps and the holds are designed to achieve a desired separation protocol.